THERMAL POWER COMPANY, Operator 8 July 1982

GEOTHERMAL WELL HISTORY KAPOHO STATE 2

State Geothermal Resources Mining Lease No. R-2
Kapoho, Puna, Hawaii, State of Hawaii

Wellhead elevation above sea level: 717.87 feet Ground Level
735.87 feet Kelly Bushing

See Licensed Surveyor's Report, 1 March 1982, for Wellhead Location

Date & Depth	Operation
	Built 10' x 10' x 10' concrete cellar with 5' wide by 1' wainscoating and installed 30" conductor pipe to 28' prior to moving in rig. All downhole measurements herein are from Kelly Bushing.
01/19/82 **54'**	Finished moving in and installing noise reduction equipment on Water Resources International Rig No. 4. Kelly Bushing located 18' above ground level. Spudded well at 1100 hours. Mixed spud mud, picked up 12¼" bit and 26" hole opener and center-punched hole to 28'. Pulled out of hole (POH), laid down 26" hole opener and drilled with 12¼" bit (#1) to 54'.
01/20/82 **103'**	Drilled 12¼" hole 6 hours to 103'. POH. Laid down 12¼" bit. Picked up 17½" reamer and opened hole to 102'. POH. Laid down 17½" tools. Picked up 26" hole opener and opened hole to 37'. POH. Picked up 26" reamer and reamed hole to 42.5'.
01/21/82 **103'**	Continued opening hole to 68'. POH. Laid down 26" tools. Lost 11" slips into hole as 26" reamer was pulled out; fished out 11" slips. Cut off 30" conductor casing and ran 2 joints 20" 94# H-40 Buttress R-3 casing, total length 85.12'; set at 68'. Cemented with construction type cement with 2% $CaCl_2$. Cement in place (CIP) 1300 hours. Cut off 20" casing and nipple up Blow Out Prevention (BOP) equipment and rotating head. Picked up 17½" bit (#2), near bit reamer, shock-sub, upper reamer and 2-11" drill collars; drilled cement from 55' to 68', cleaned out fill to 91.4'. Note: one ± 5.4 Rm earthquake felt at site.

01/22/82 **174'**	Mixed mud and cleaned out to 103'. POH, laid down 1-11" drill collar and picked up double stand of 11" drill collars. Hooked up rotating head. Deviation survey at 92' was 0° 15'. Tripped in hole with 17½" bit (#2), near bit reamer, 11" shock-sub, 11" stabilizer/reamer, 3-11" drill collars, 1-8" drill collar and 3 cross-over subs (x-0 subs). Drilled 71' to 174'.
01/23/82 **250'**	Drilled 86' of hole in 6½ hours to 250'. POH. Secured rig for weekend shutdown at 2000 hours. Deviation survey at 217' was 0° 15'.
01/24/82 **250'**	Shut down for weekend.
01/25/82 **300'**	Started up and serviced rig and accessory systems at 0800 hours. Changed to new 17½" bit (#3); made repairs to hook. Tripped in to hole with drilling assembly and drilled 50' of hole to 300' in 5 hours.
01/26/82 **616'**	Drilled 316' of hole in 21½ hours to 616'; lost mud returns at 321'. Stopped twice, once to repair goose neck and once to install fan belt to air compressor.
01/27/82 **750'**	Drilled 134' of hole in 13½ hours to 750'; no mud returns. Spotted 200 bbls mud at 700'. POH. Pump 100 bbls mud down hole with mud pump. Deviation survey at 720' was 0° 45'. Rigged up to bail hole.
01/28/82 **765'**	Bailed hole for water sample for Hawaii DLNR. Fluid level found at 724' KB, 706' below ground level and 12' above sea level. Removed sand line off drum. Made repairs to hook. Tripped in to hole, mixed mud, spotted 200 bbls on bottom. Cleaned out fill to 750'. Drilled new 17½" hole to 765'; no mud returns.
01/29/82 **923'**	Drilled 158' of 17½" hole with gel mud for 23½ hours to 923'. ½ hour servicing rig.
01/30/82 **942'**	Drilled 19' of 17½" hole to 942'; no mud returns. Circulated and conditioned hole and POH. Deviation survey at 904' was 1° 00'. Secured rig for weekend shut-down at 0730 hours.
01/31/82 **942'**	Shut down for weekend.
02/01/82 **987'**	Started and serviced rig at 0800 hours. Ran new 17½" bit (#4) in hole, mixed mud and drilled 45' of hole to 987'; no mud returns.

02/02/82
1232'

Drilled 245' of 17½" hole with gel mud to 1232'; no mud returns.

02/03/82
1315'

Drilled 83' to 1315' in 19½ hours without mud returns. POH to 1160', mixed 250 bbls mud and lost circulation material (LCM). RIH to bottom, spotted 250 bbls mud and LCM. POH. Fluid level noted at 550' in wellbore.

02/04/82
1315'

Laid down 17½" tools. Cut off 20" casing and cleaned off cellar. Mixed mud and LCM. Pumped 500 bbls LCM mud while dumping cane pellets from surface. Mixed more LCM mud. Tripped in, washed from 1287' to bottom. POH to 1160'. RIH and found no fill. POH, laid down 17½" tools. Rigged up to run casing. Mixed 300 bbls of mud in pits.

02/05/82
1315'

Ran 30 joints 13-3/8" 54.5# K-55 Buttress R-3 and 3 joints 13-3/8" 61# K-55 Buttress R-3 on top. Guide shoe and float collar on bottom joint. Total string length was 1314.45'. Casing set at 1313'. Rigged cementers and pumped 350 bbls mud with 10-15% LCM, vis 65 sec., had no returns. Pumped 10 bbls water followed by 1153 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2 and 2% $CaCl_2$. Total slurry was 1477 cu. ft., 65% in excess of volume needed. Weight was 12.6-12.8 pounds per gallon (ppg). Displaced plug with 198 bbls water and bumped plug with 800 psi. CIP at 1130 hours. WOC 10½ hours. Cutoff 13-3/8" casing. Picked up 1.6" tubing, tagged cement at 564' in annulus. Mixed and pumped 143 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 2230 hours. Cement slurry weight was 13.4 ppg. WOC.

02/06/82
1315'

WOC, 5 hours total. Picked up tubing, tagged cement at 540'. Pumped cement plug (#2) with 210 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 0430 hours. WOC. Fluid level recorded at 434'. Laid down tubing. Shut down and secured rig for weekend.

02/07/82
1315'

Shut down for weekend.

02/08/82
1315'

Started and serviced rig and accessory systems at 0800 hours. Picked up and tagged cement with tubing at 463'. Pumped cement plug (#3) with 130 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2. CIP at 1045 hours. WOC 3½ hours. Blended new cement. Tagged cement with tubing at 454'. Pumped cement plug (#4) with 100 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 1520 hours, WOC 1½ hours. Pull out all 14 joints 1.6" tubing. RIH with same tubing 7 joints. Pumped cement plug (#5) with same volume and composition as plug #4. CIP at 1800 hours. WOC 4 hours. Pumped cement plug (#6) with same volume and composition as plug #4. CIP at 2215 hours. WOC.

02/09/82
1315'

WOC, 2½ hours total. Pumped cement plug (#7) with same volume and composition as plug #4. CIP at 0130 hours. WOC 2½ hrs. (Tubing is resting at 350'). Pumped cement plug (#8) with same volume and composition as plug #4. CIP at 0430 hours. WOC 3½ hours. Pumped cement plug (#9) with same volume and composition as plug #4. CIP at 0730 hours. WOC 2½ hours. RIH with tubing and tagged cement at 386'. Pumped cement plug (#10) with 200 cu. ft. composed as in plug #4. CIP @ 1130 hours. WOC 1 hour. POH and laid down tubing. Mixed Redimix 1:1 with sand, 40% silica flour, and 2% $CaCl_2$. Pour 8 cu. yds. from surface. WOC 1 hour. Again, pour 8 cu. yds. and WOC 4½ hours. RIH and tagged cement with tubing at 286'. Pumped cement plug (#11) with 147 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, and ½% CFR-2. CIP at 2100 hours. WOC.

02/10/82
1315'

WOC, 4 hours total. Tagged cement with tubing at 296'. Pumped cement plug (#12) with 130 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel and ½% CFR-2. CIP at 0130 hours, WOC 4½ hours. Tagged cement at 296'. Pumped cement plug (#13) with same volume and composition as plug #12. CIP at 0700 hours. WOC 6 hours. Pulled and laid down tubing. Blended new cement. RIH and tagged cement with tubing at 352". Pumped cement plug (#14) with 60 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 1330 hours. WOC 3½ hours. Pumped cement plug (#15) with same volume and composition as plug #14. CIP at 1750 hours. WOC 3 hours. Pumped cement plug #16 with same volume and composition as plug #14. CIP at 2100 hours. WOC 3 hours. Laid down tubing.

02/11/82
1315'

WOC 3½ hours total. Pumped cement plug (#17) with same volume and composition as plug #14. CIP at 0100 hours. WOC 3 hours. Pumped cement plug (#18) with same volume and composition as plug #14. CIP at 0430 hours. WOC 13 hours while cleaning cellar and waiting for new cement. Mixed Redimix 1:1 with sand, 20% silica flour, 1% $CaCl_2$, and poured two slugs of 8 cu. yds. from surface, with 1½ hours between pours. CIP at 2130 hours. WOC 2½ hours.

02/12/82
1315'

Poured 8 cu. yds. same as above. CIP at 0030 hours. WOC 7½ hours. RIH and tagged cement with tubing at 322'. Mixed Redimix cement 1:1 with ½" gravel, 40% silica flour, 3% $CaCl_2$, and poured four 1½ cu. yd. slugs ½ hour apart, 6 cu. yds. total. Tagged cement with tubing again at 322'. Mixed same Redimix mixture above and poured 2 slugs of 1½ cu. yd., then one slug of 5 cu. yds. each 30 minutes apart. WOC 1 hour. Tagged cement with tubing still at 322'. Dumped 7 cu. yds. of ¼" pea-gravel mixed with 10 bags cottonseen hulls in effort to pack off hole. Tagged top of gravel/cement still at 322' with tubing. Pulled out and laid down tubing. Dumped 14 cu. yds. ¼" pea-gravel and 8 bags cottonseed hulls, tagged top still at 322'. Pulled out tubing.

02/13/82
1315'

Dumped 15 cu. yds. ¼" pea-gravel from surface, tagged top again at 322'. Mixed and poured 8 cu. yds. of Redimix 1:1 with ½" gravel by pouring two-1½ cu. yds. slugs and then one 5 cu. yds, ½ hour apart. Shut down and secured for weekend. A total of 40 tons of ¼" pea-gravel were poured in plug attempt.

02/14/82
1315'

Shut down for weekend.

02/15/82
1315'

Shut down for weekend.

02/16/82
1315'

Picked up and tagged top of cement/gravel with tubing at 322' at 0800 hours. Dumped approximately 40 cu. yds. ½" volcanic cinders from surface. Tagged top of cinders at 320.5'. Dumped another 40 cu. yds. of ½" volcanic cinders.

02/17/82
1315'

Dumped another 25 cu. yds. of ½" volcanic cinders from surface. Tagged top of cinders at 320.5' with tubing. Rigged and dropped simultaneously four ½" x 20' lengths of rebar fixed each with one barbed wire tail, 50', 200', 240', and 260' in space between 13-3/8" and 20" casing. Was able to cement to surface with 7 cu. yards Redimix 1:1 with ½" gravel and 2% $CaCl_2$. CIP at 1300 hours. Cleaned off cellar. Cut off 13-3/8" casing. Mixed up gel mud in two pits. Rigged down tubing and cement tools. Welded up 13-3/8" Bradenhead wellhead.

02/18/82
1315'

Nippled up BOP stack. Pressure tested blind rams to 1000 psi - 15 minutes - held OK. Picked up old 12¼" bit, sub, 3-11" drill collars, 3 subs, 6-8" drill collars. Tripped in hole. Tested pipe rams to 1000 psi - 15 minutes - held OK. Tested Hydrill to 400 psi - 15 minutes - held OK. Drilled out float collar and 40' of cement to 1308'. POH mixed new gel mud. Changed to new 12½" bit (#6).

02/19/82
1384'

Deviation survey at 1300' was 1° 00'. RIH, drilled cement and casing shoe at 1313', cleaned out to 1315'. Circulated mud at 1315' for 4 hours while replacing damaged rotary chain. Drilled new 12¼" hole to 1357'. Tripped out, changed to new 12¼" bit (#7), tripped in, continued drilling. Tripped 1 hour to repair rotary chain guard. Continued drilling to 1384'.

02/20/82
1695'

Drilled 311' of 12¼" hole with 37 sec. viscosity gel mud to 1695' in 24 hours. Lost 20 bbl/hr. at 1500', 225 bbls total through drilling period.

02/21/82
1910'

Drilled 215' of 12¼" hole to 1910' in 24 hours. No mud loss.

02/22/82
2118'

Drilled 53' of 12¼" to 1963'. Tripped out of hole. Deviation survey at 1936' was 0° 45'. Changed to new 12¼" bit (#8). Cleaned shaker pit. Tripped in, cleaned 30' of fill off bottom. Drilled 155' of new hole to 2118'.

02/23/82
2444'

Drilled hole with gel mud. Lost 100 bbls mud from 2135'-2150'. Halted drilling. ½ hour to clean shaker pits. Resumed drilling, lost 100 bbls mud 2440'-2444'.

02/24/82
2701'

Drilling 257' of 12¼" hole to 2701'; minor mud loss at 2624'. Stopped ½ hour to clean #2 pit and shaker pit.

02/25/82
2996'

Drilled 295' of new hole to 2996'; no loss circulation this interval. ½ hour to clean shaker pit.

02/26/82
3242'

Drilled 246' to 3242'. ½ hour to clean #3 and shaker pit.

02/27/82
3353'

Drilled 51' in 5 hours to 3293'. Tripped out for bit change. Laid down 1 shock sub; pick up 1-11" x 20' drill collar plus new 12¼" bit (#9). Cut 56½' off of drilling line and rigged new line. Deviation survey at 3283' was 1° 30'. Tripped in hole, with drilling assembly (12¼" bit (#9), 2-12¼" near-bit reamers, 4-11" x 20' drill collars, 2-X-0 subs, 6-8" x 20' drill collars equalling 321.68'). Cleaned 5' of fill off bottom and drilled 60' of 12¼" hole to 3353'.

02/28/82
3561'

Drilled 214' of new hole to 3567'.

03/01/82
3819'

Drilled 252' of new hole to 3819'.

03/02/82
4111'

Drilled 292' of new hole to 4111'. 3^{o} temperature kick at 4028' along with 10 bbl loss.

03/03/82
4217'

Drilled 106' of new hole to 4217' in 4½ hours. Stopped drilling and circulated hole for logs. POH. Rigged up and ran temperature log (#1), Gamma-Ray Neutron log, X-Y Caliper, Resistivity log, Cement Bond log and additional temperature logs (#2 and #3). All logs were to 4214' except the CBL which was to 1313'.

03/04/82
4217'

Finished logging and rigged down. Start in hole and found no fill on bottom. Circulated hole at 4214' for 2 hours, conditioning for 9-5/8" casing. POH and laid down all drill pipe, collars and tools.

03/05/82
4217'

Ran 13 joints of 9-5/8" 40# N-80 Buttress T&C R-3 following 62 joints 9-5/8" 40# K-55 Buttress T&C R-3 casing with float collar and shoe on first joint. Casing was hung in 9-5/8" x 13-3/8" Midway hanger at 1096'. Shoe was run to 4214', pulled up and set at 4209'. Total pipe length was 3104'. Circulated casing shoe at 3233' for ½ hour. Pumped 100 bbls cool mud, 10 bbls cool water, 16 bbls salt gel flush (30 lbs/bbl), second 10 bbl slug of water, 30 bbls Flo-check and third 10 bbl slug of water. Cemented casing with 1021 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ¼% CFR-2 and 0.4% HR-7. Slurry weight was 12.7-13.3 ppg. Chased with 350 cu. ft. cement with 40% silica flour, 3% gel, ½% CFR-2, 0.4% HR-7 at 14 ppg slurry weight. CIP at 1400 hours. WOC 8 hours. Released liner, pulled pipe 60' up. circulated in 13-3/8" casing, no cement returned to surface in circulating material. Laid down drill pipe and changed out kelly.

03/06/82
4217'

WOC 8 hours. Picked up 16-6 3/4" drill collars and 12-3/4" bit. Tripped in hole, tagged top of cement at top of liner (1096') no cement was above liner. Pressure tested liner lap to 1200 psi, took water at 4 bbl/min pressure dropped to 300 psi. Rigged up to squeeze cement. RIH with open ended drill pipe (OEDP) to 1040' and squeezed 102 sacks cement mixed with 40% silica flour, 3% gel, ½% CFR-2. CIP at 1500 hours, Displaced pipe with water to 1076', left 20' of cement above liner top. POH and WOC 4½ hours. Trip in hole with 12¼" bit, tagged top of liner at 1096', no cement on liner top. POH.

03/07/82
4217'

Pressure tested liner lap to 1000 psi for 15 minutes. Held OK. Laid down 12¼" bit and picked up 8-3/4" bit. RIH to 1104' and drilled cement to 1109'. RIH to 1601'. Pressure tested pipe rams to 1000 psi for 15 minutes. Held OK. POH and laid down pipe. Rigged up for logging and ran 22 joints 9-5/8" 36# K-55 Buttress T&C R-3 with stinger (liner attachment) on bottom and float collar on top of first joint and then 5 joints 9-5/8" 40# K-55 Buttress T&C R-3. Stinger set at 1096', total length of string was 1103.4'. Cemented by pumping 567 cu. ft. Cement mixed with 40% silica flour, 3% gel and ½% CFR-2, slurry weight was 15.3-15.5 ppg. 15 bbls cement surfaced and was sumped. CIP at 2230 hours.

03/08/82
4217'

WOC 17½ hours and cut off 9-5/8" casing, nippled up expansion spool and flow nipple. RIH with 8-3/4" bit, drilled out cement and float collar 1040' to 1096' through 9-5/8" casing tie back element. Picked up additional 4" drill pipe and RIH to clean out 9-5/8" casing float collar at 4165'.

03/09/82
4217'

Picked up and stood 4" drillpipe in derrick while cleaning out cement to 4214'. POH. Laid down 12½" bit (#10). Ran cement bond log 0' to 4214'. RIH to 1500' with OEDP, mixed and pumped 43 cu. ft. cement for a 100 liner foot cement plug. Displaced pipe with water and POH. Pulled flow nipple from wellhead stack and nippled up BOP. WOC 5½ hours. Mixed salt gel mud to use as flush when required on water below 4217'.

03/10/82
4217'

Finished nippling up BOP on 9-5/8" casing. Tested blind rams and choke manifold to 1200 psi for 15 minutes - held OK. Picked up 8-3/4" bit (#11), 6½" near-bit reamer, 2-6½" stabilizer subs (36' and 96' above bit), and 16-6 3/4" drill collars. Tripped in hole 1000'. Tested pipe rams and kelly stop at 1200 psi for 15 minutes - held OK. Tested Hydril to 600 psi for 15 minutes - held OK. Tripped in hole to 1395', tagged top of cement and drilled same to 1458'.

03/11/82
4616'

Finished drilling out cement to 1490' and circulated hole clean. RIH to bottom and began drilling new 8-3/4" hole with water. Drilled 399' of hole to 4616' stopping 1½ hour to pull bit into 9-5/8" casing and pack the swivel. There was a 3° temperature kick at 4460'.

03/12/82
5221'

Drilled 8-3/4" hole until 0600 hours where ½ hour was taken to repair leaks in mud line unions. Resumed drilling for a 605' total to 5221'. Cleaned out shaker pit. Noted a 3° temperature kick at 5069'.

03/13/82
5623'

Drilled 402' of 8-3/4" hole to 5623' in 13½ hours. Lost 8-10 bbl/hr during drilling. Stopped drilling and circulated hole for bit change. POH while cleaning mud return pits. Deviation survey at 5599' was 4° 45'. Changed to new 8-3/4" bit (#12). Tripped collars in hole, set rotating head and cut 59½' of drilling line.

03/14/82
6202'

Finished cutting drilling line. RIH to 4200' circulating. Break circulation and RIH to 5623', found no fill on bottom. Drilled new 8-3/4" hole 579' to 6202' in 21 hours. Cleaned shaker pits. Dumped in 50 sacks of fine mica to halt 50 bbl/hr fluid loss which began at 5921'.

03/15/82
6456

Drilled 254' to 6456' in 12½ hours. Tripped out to change bit and found one bearing seal was lost (attributed to heat) and parts left in hole. Changed to new 8-3/4" bit (#13) and put junk sub above bit to collect parts left from bit #12. RIH, circulating 20 minutes at 4000' and 5500', resumed drilling.

03/16/82
6618'

Drilling 416' to 6618' in 10½ hours using water. Circulated for trip out to change bits. Tripped out, laid down bit #13 and junk sub. Deviation survey at 6600' was 5° 00'. RIH with new 8-3/4" bit (#14), circulated to cool bit 15 minutes each, at 4000', 4600', 5200', 5800', and 6200' and reamed 50' of fill off bottom.

03/17/82
7029'

Finished reaming to bottom. Drilled 591' of new hole to 7029' in 23 hours. Lost 30-50 bbl/hr during this period, specifically at 6638 and 6695'.

03/18/82
7073'

Drilled 44' in 3 hours to 7073'. Hole got tight, worked tight drill pipe out of hole to 6980'. Circulated 1½ hours and washed back to bottom. Pumped 100 bbls mud through well. POH and was still tight to 6980'. Tripped out of hole, laid down near bit reamer and 2 stabilizers. Cut 14½' off drilling line. Changed out rotating head rubbers while waiting on water to be hauled to site. Filled pits with water. Bit #14 was found to have two blown seals and loose cones. RIH with 8-3/4" bit (#15), 2 subs and 16-6 3/4" drill collars. Circulated 15 minutes each at 4555', 5272', 5898', 6520', 6800' and 6955'. Washed hole last two joints and found no fill.

03/19/82
7150'

Finished washing hole. Began drilling new 8-3/4" hole. Began caving in at 7150'. Worked 5 tight joints of drill pipe out of hole to 6680'. Regained lost circulation, POH to shoe of 9-5/8" casing. Decided to convert to mud drilling fluid to protect deep wellbore. Circulated and replaced water with mud to shoe of 9-5/8" casing. Rebuilt mud volumes in pits.

03/20/82
7213'

RIH, circulating mud 10 minutes at 600' intervals to cool bit and replace water with mud. Reamed 190' of fill to bottom and circulated 100 bbls heavy mud, brought up cuttings. Drilled 63' to 7213' in 3 hours, at 7213' suddenly lost 500 bbls at 270 bbl/hr rate. Tripped and circulated in effort to regain lost circulation. POH to 9-5/8" casing shoe and regained lost circulation. Mixed mud; filled hole and mud pits. Tripped in hole circulating 15 minutes at 600' intervals to 7048'. Cleaned 90' of fill to 7203'.

03/21/82
7236'

Finished cleaning to bottom, circulated and conditioned well at 7156'. Cleaned remaining 30' of fill to bottom and then lost all returns. POH to 6583', built up mud volume in pits and well. RIH to 7090', circulated and washed to 7183' and circulated there with high viscosity (80 sec., 8.6 ppg) mud. Able to drill new hole 1½ hour to 7227'. Tripped and circulated for bit change. Tripped out. Changed to new 8-3/4" bit (#16). Did rig repairs, RIH to 9-5/8" casing shoe, circulating each 15 minutes, and circulated thereafter 15 minutes at 600' intervals to bottom cleaning 60' of fill. Began drilling new hole 9½ hours to 7236' losing 150 bbls.

03/22/82
7554'

Drilled 10 hours, circulated bottoms up at 7398', pulled up to 6444'. Tripped back in, found and cleaned 74' of fill. Drilled another 11 hours for a total of 311' to 7554'.

03/23/82
7897'

Drilled 343' of 8-3/4" hole with mud to 7897'.

03/24/82
8005'

Drilled 108' in 9 hours to 8005' (TD). Circulated for 2 hours. Worked tight pipe out of hole first 7 joints losing 200 bbls of mud. Pulled to 4170'. Cut portion of drilling line. Tripped in hole to 7764' and circulated for 10 minutes. RIH found top of fill at 7821' and circulated 3 hours. Allowed pipe to sink in fill, found it soft, 10,000 lb. going in, 20,000 lbs. to pull out of fill. Pulled up and circulated at 7764' for Electric logs.

03/25/82 **8005'**	Circulated at 7764' and at 7804' for 12 hours for logs. Tripped out of hole. Rigged up and ran Temperature log 200' to 4260'. Rigged down and laid down drill collars.
03/26/82 **8005'**	RIH with 7" x 9-5/8" liner hanger on end of 64 lengths drill pipe. Set liner at 7816'. POH. Rigged up and ran 90 joints, 7" 23# K-55 Long T&C R-3 liner perforated with ½" holes on 3" centers, 10 rows and 3 joints solid 7" 26# N-80 Long T&C R-3 on top. Set liner on top of fill at 7816.2'. String was 3835.2' long with top of hanger at 3981'. POH with liner tools and laid same down. Trip in with float sub on bottom of drill pipe and dislaced mud with water at 4000' and 6000'. Tripped in and washed hole 7636'-7816' displacing mud with water. POH and rigged up to log. Well took 200 bbls of water at 30 bbl/hr during circulation.
03/27/82 **8005'**	Ran Gamma-Ray Neutron log 4150'-6005' and two Temperature logs 100'-5975'. Secured rig for weekend shutdown.
03/28/82 **8005'**	Shut down for weekend.
03/29/82 **8005'**	Opened well and tried to flow. No flow. Rigged up and ran wireline temperature survey with Kuster tool. Temp. @ 3620' = 200° F Temp. @ 7816' = 619° F
03/30/82 **8005'**	Finishing temperature logging. Hook up air compressor to blow well free of water head. RIH with OEDP to 615' and blow off water. RIH to 1100' and blow off water. RIH to 1400' and blow off water.
03/31/82 **8005'**	Blow off water at 1400'. RIH to 1640' and blow off water. POH to 1400' and blow off water. RIH to 1820' and blow off water, 300° F slugs of water came up, closed pipe rams on 9" drill pipe. Well flowing hot, strong-dirty. Flow cut out a hole in manifold of 6" flow line. Shut in well with maximum WHP of 353 psig.
04/01/82 **8005'**	WHP at 0 psig. POH with 4" drill pipe. Ran wire with sinker bar, bar hit bridge at liner top (3835'). POH with sinker bar. RIH with 6" drill bit and knocked out bridge at 3835', found well clear to 4231'. Tripped bit out. Ran sinker bar, bar hit bridge at 5052'. Elected not to go back in hole to knock out bridge. Began temperatre logging.

04/02/82 **8005'**	Completed temperature logging. Temperature at 5000', was 543° F. Laid down 4" drill pipe and Kelly. Ran fluid level indicator, level at 495'. Installed second 900 Series WKM 10" gate valve. Rigged down equipment. Released rig at 1800 hours on 4-2-82.

Verified:

W. L. D'Olier
Vice President, Exploration

SSW/ikl
08/04/82

THERMAL POWER COMPANY - Operator

Kapoho State 2

Static Wellbore Temperature Survey* - 4/29/82

Depth in Feet	Temperature	
	°C	°F
4000	322.2	611.9
4200	324.7	616.5
4400	326.8	620.2
4600	328.5	623.3
4800	330.4	626.7
5000	332.6	630.6
5200	334.7	634.4
5400	336.5	637.5
5600	338.0	640.3
5800	339.7	643.4
6000	341.6	646.8
6200	343.8	650.9
6400	344.7	652.5
6600	346.2	655.1
6800	347.4	657.3
6916	348.8	659.9

* Pruett Wireline Service; tool stopped at 6916 feet probably on mud bridge.

SSW/ikl
08/03/82
HA-PU-BR-B01

THERMAL POWER COMPANY - Operator
Kapoho State 2

Wellbore Deviation Survey

Depth in Feet	Deviation in Degrees
92	0.25
217	0.25
720	0.75
904	1.00
1300	1.00
1936	0.75
3283	1.50
5599	4.75
6347	5.00
6600	5.00 (to bottom)

True depth	=	7995.03 feet
Possible maximum drift from center	=	399.32 feet

SSW/ikl
08/03/82
HA-PU-BR-B01

10 August 1983

KAPOHO STATE 2 WELL ACTIVITY SUMMARY

Drilling and Completion

- Spud and Completion Dates: 19 January to 2 April 1982.
  - Total Depth: 8005'
  - Drilling Days: 56
- Casing

30"	0-28' KB[1] (cemented)
20"	0-68' KB (cemented)
13-3/8"	0-1313' KB (cemented)
9-5/8"	0-4209' KB (cemented)

- Liner

  7" perforated: 3981-7891' KB (standing in 8-3/4" wellbore).

- Lost Circulation Zone(s) (Amount)

321-1320'	(total)	2624'	(5 bbls/hr)
1390'	(60 bbls)	4028'	(10 bbls)
1495'	(20 bbls)	5921'	(50 bbls/hr)
1540-1580'	(?)	6400'	(16-34 bbls/hr)
1654'	(24 bbls)	6780'	(60 bbls/hr)
2145'	(80 bbls/hr)	6950'	(50 bbls/hr)
2185'	(30 bbls)	7210-7213'	(280 bbls/hr)
2435'	(12 bbls)		

- A limited suite of geophysical wireline logs were run.

Completion Rig Test (Test Series #1)

A rig test March 30-31, 1982 required approximately 33 hours of air lifting through 4" drill pipe (between 615-1820') to initiate flow. Test was terminated after flowing for 1 hour and 15 minutes because of erosion in the flow line by particulate matter associated with the producing fluid. Stabilized flow conditions were not achieved. Maximum FWHP and FWHT were 455 psig and 457°F.

Temperature/Pressure Surveys

As one of the means to assess wellbore conditions, temperature/pressure surveys were run immediately after completion, and both prior to and after Test Series 2 . Maximum temperature, 670°F and pressure, 2300 psig, were measured at the bottom (6905' and 6500', respectively) of the 24 April 1982 survey. These surveys suggest both interzonal flow and the presence of two-phase flow.

[1]All measurements are relative to the Kelly Bushing.

Test Series #2

The second flow test, conducted on 20 April - 1 May 1982, was designed to clean up the flow, achieve stabilize flow and measure well performance at several different orifices. Seventeen individual flow periods took place. However, throughout the duration of testing, (1) stabilized flow was not achieved, (2) the well continued to produce particulate matter, and (3) a bridge was present in the wellbore at a depth of about 6914'. Maximum FWHP and FWHT were 1333 psig and 583°F.

Loss of Temperature/Pressure Tools and Wireline

On 6 May 1982, during a routine temperature/pressure survey under shut-in conditions at a depth of 6200', the wireline parted at a depth of about 2000'. Approximately 4200' of wireline and the survey tools were dropped in the hole. The wireline used was standard 0.092" carbon plow steel. Prior to this, 10 wireline temperature/pressure and sinker bar surveys were successfully conducted with the loss of only the bottom 100-1000' of wire due to embrittlment. This last survey was made with a new spool of wire. The shallow break was and still is an engima.

Fishing Operation

On 11 May, a fishing operation was conducted. Upon pulling out of the hole at the depth of 3400', the wireline broke at 2400', leaving 1000' of wireline, the fishing tools and previous tools and wire in the hole. The repeated loss of wireline resulted in a temporary deferment of all logging and testing operations until this material problem was resolved.

Material Testing and Wellbore Surveys

The lack of wellbore flowing and/or static surveys were becoming an obstacle in analyzing well performance. With the loss of 0.092" carbon-steel wireline in Kapoho State 2, an extensive investigation was conducted for the appropriate type of wireline to use in this geothermal environment. After discussions with metallurgists from the steel industry, oil and geothermal companies, and national laboratories, and field personnel from Union's Philippines and Imperial Valley, CA, geothermal operations, Sanicro-28 stainless steel was chosen for service. On 24 August 1982 during Test Series 4, Sanicro-28 was run successfully into and out of the KS-1 wellbore, but the entire length of run into the well wire was found to have been embrittled. No further surveys were conducted and a study was undertaken by both metallurgists from the manufacturer and Dr. D. Douglas, a UCLA engineering professor and a Thermal consultant. Analysis indicated that Type 310 stainless steel with moderate tensile strength would be the most cost-effective material to use.

Shut-in Wellhead Pressure Monitoring

With the realization of interzonal flow and the consequent formation of a gas cap, daily shut-in wellhead pressure monitoring was initiated.

Test Series #3

The third series of testing was conducted between 3-15 June 1982 with a four-fold objective (1) to clean the wellbore of tools and wire, (2) to break the bridge below 6900', (3) to clean up the fluid flow and (4) to characterize the well's flow performance. During the test a relatively small amount of metal debris was produced. No wellbore surveys were conducted so that the status of the bridges could not be ascertained. Production of particulate matter was demonstrately reduced and the wellflow was considered clean. Distorted lip pressure and flowing wellhead pressure data caused by mineral precipitates from the reaction of the abatement chemicals with the produced geothermal fluid building up in the lip pressure port and discharge line, precluded accurate determination of well performance. The field observation that the flow became wetter near the end of the test was made.

"Running-Faucet" Sound at Wellhead

Around 20-23 June 1982, a running-faucet sound was emanating from the Kapoho State 2 wellhead. A wellbore evaluation program was designed utilizing the geophysical wireline logging cable and tools.

Wellbore Evaluation

On 14 July 1982, while pumping cold water into the wellbore, a temperature survey was conducted. A casing leak was detected at approximately 1040-1050'.

Test Series #4

A flow test utilizing a separator system was conducted on 28 July - 2 August 1982. Steam fraction, enthalpy and flow rate were accurately measured and found to vary significantly with wellhead pressure. The well produced a steam/water mixture at FWHP less than 145 psig, and a fluid with a 92-96% steam fraction at FWHP greater than 145 psig. A 100% steam flow rate of 33,000 lbs/hr was measured at a FWHP of 173 psig.

Casing Leak Evaluation/Metallurgical Testing

On 25 January 1983, temperature/pressure surveys were conducted to evaluate the wellbore and test the recommended 310 stainless steel wireline. The operation was successful with the survey reaching a total depth of about 4800'. It confirmed only one casing leak, as previously indicated. No embrittlement of the wireline was observed in the field and discussions with Dr. Douglas indicated that additional study was not warranted at this time.

Remedial Program

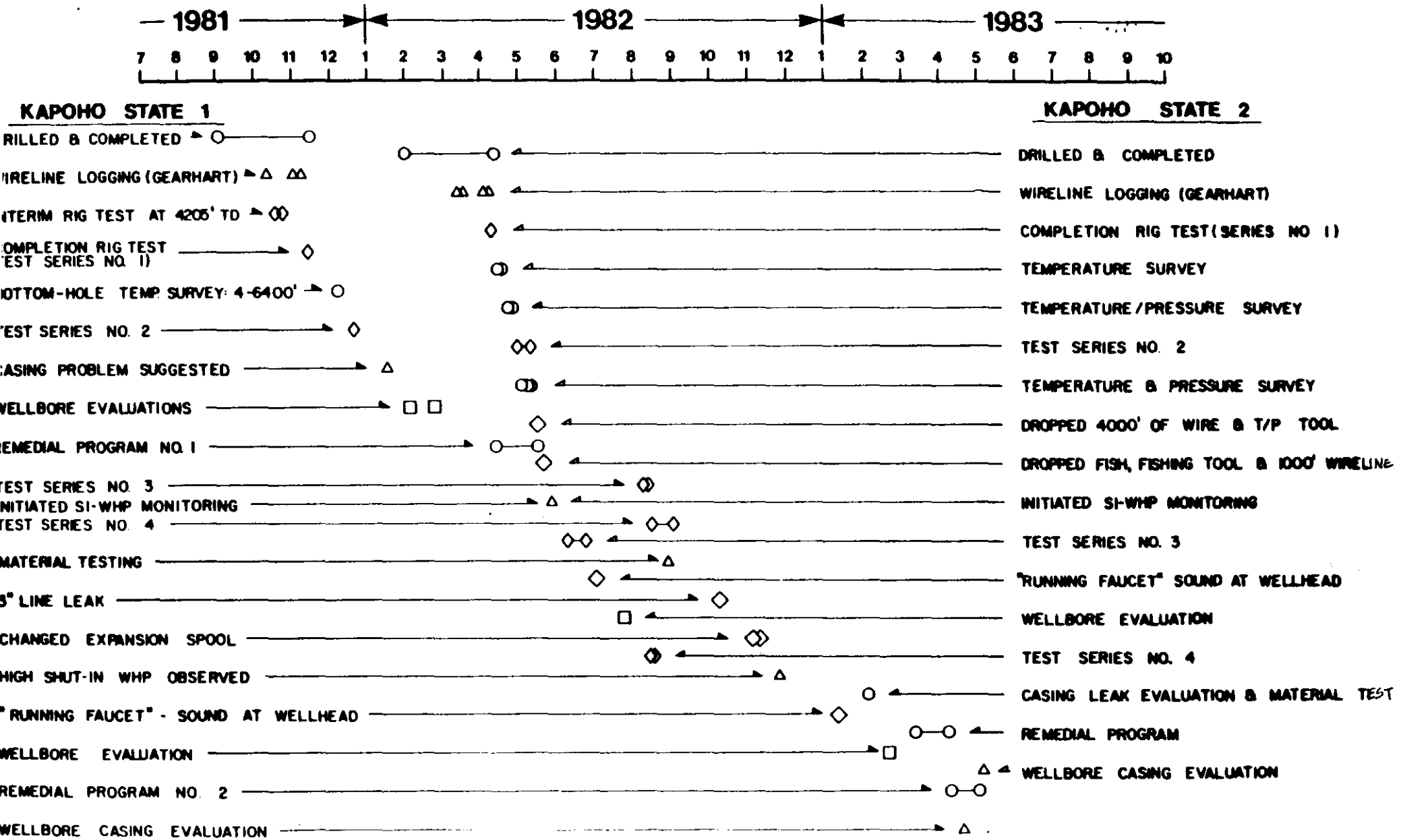
Review of the casing collar log and casing tally logs indicated a 4-foot gap at the 9-5/8" casing tieback between 1093-1097'. A remedial program designed to cement squeeze the leak and to clear the wellbore of any bridges was initiated on 2 March 1983. A cement plug was set at 1434' (top 1291') and six cement squeezes proceeded, all unsuccessfully. Cement squeezing was considered non-workable at this time; the cement plug was drilled out; and drill pipe was run to about 3976' where an obstruction was encountered interpreted to be wireline junk at the top

of the 7" liner (3981'). The casing from 3727' to 1202' was pressure tested and found integral. A wireline spear was run to 3977' with no recovery. Drilling on junk, spearing and milling to 4119' took place. The hole was worked to a maximum depth of 4645'. Pulled out of hole, ran in and could not mill by 4396'. Substantial amounts of drill cuttings came out of hole at this depth, but no wireline debris was recovered. A cement plug was emplaced at 3175' pending further evaluation. Operation was terminated on 29 March 1983.

Wellbore Casing Evaluation

On 15 April 1983, Dia-log caliper logs were run to a depth of about 2976' to determine the condition of the 9-5/8" casing. Interpretation of these logs suggests minor pitting and/or erosion, a small hole at 975', the 4-foot gap at the tieback (as previously determined) and probable incorrect logging of a float collar on the casing records (1092' in records vs. 1052' on log). Logging engineer rated logged casing interval to be in generally fair to good condition.

JLI/ikl/crn


1981
1982
1983
7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10
KAPOHO STATE 1
RILLED & COMPLETED
IIRELINE LOGGING (GEARHART)
ITERIM RIG TEST AT 4205' TD
OMPLETION RIG TEST
EST SERIES NO. 1)
OTTOM-HOLE TEMP SURVEY: 4-6400'
EST SERIES NO. 2
ASING PROBLEM SUGGESTED
VELLBORE EVALUATIONS
EMEDIAL PROGRAM NO. 1
TEST SERIES NO. 3
NITIATED SI-WHP MONITORING
TEST SERIES NO. 4
MATERIAL TESTING
3" LINE LEAK
CHANGED EXPANSION SPOOL
HIGH SHUT-IN WHP OBSERVED
" RUNNING FAUCET" - SOUND AT WELLHEAD
WELLBORE EVALUATION
REMEDIAL PROGRAM NO. 2
WELLBORE CASING EVALUATION
KAPOHO STATE 2
DRILLED & COMPLETED
WIRELINE LOGGING (GEARHART)
COMPLETION RIG TEST (SERIES NO 1)
TEMPERATURE SURVEY
TEMPERATURE/PRESSURE SURVEY
TEST SERIES NO. 2
TEMPERATURE & PRESSURE SURVEY
DROPPED 4000' OF WIRE & T/P TOOL
DROPPED FISH, FISHING TOOL & 1000' WIRELINE
INITIATED SI-WHP MONITORING
TEST SERIES NO. 3
"RUNNING FAUCET" SOUND AT WELLHEAD
WELLBORE EVALUATION
TEST SERIES NO. 4
CASING LEAK EVALUATION & MATERIAL TEST
REMEDIAL PROGRAM
WELLBORE CASING EVALUATION

WELL SUMMARY REPORT - GEOTHERMAL

Operator	Well name and number				
THERMAL POWER COMPANY	KAPOHO STATE 2				
Field	**County**	**Sec.**	**T.**	**R.**	**B.&M.**
PUNA	HAWAII	SEE SURVEY REPORT			

Location (property or section corner, or street center lines)
STATE GEOTHERMAL RESOURCES MINING LEASE R-2
KAPOHO, PUNA, HAWAII. (LICENCED SURVEYERS REPORT SHOWS EXACT LOCATION

Elevation of ground (feet above sea level): 717.87'

Commenced drilling (date)	Total depth (feet)	Plugged depth (feet)
1-19-82	8005'	N/A
Completed drilling (date)	Geologic formation and age at total depth	
4-2-82	BASALT	
Commenced producing (date)		
N/A		

Depth measurements taken from top of: ☐ Derrick floor ☐ Rotary table ☒ Kelly bushing
Which is 18 feet above ground.

Junk	Geologic marker(s)	Depth (feet)
NONE	NONE	N/A

DATE	STATIC TEST (Shut-in well head)		PRODUCTION TEST DATA									
			Total mass flow data					Separator data				
	Temp °F	Press psig	lb/hr	Temp °F	Press psig	Enthalpy	Orifice	Water lb/hr	Steam lb/hr	Press psig	Temp °F
3-31-82	448	605	305,000	387	230	--	--	--	--	--	--

CASING RECORD (present hole)

Size of casing (A.P.I.)	Top of casing ft	Depth of shoe ft	Weight of casing lbs	New or second hand	Seamless or lapweld	Grade of casing	Size of hole drilled in	Volume of cement yd^3	Depth of cementing if through perforations ft
30"	SURFACE	28'	-			-	-	-	
20"	"	68'	94			H40	26"	12	
13 3/8"	"	1313'	54.5,61	ALL	SEAMLESS	K55	17½"	408	N/A
9 5/8"	"	4209'	36, 40	NEW		K55, N80	12¼"	190	
7"	3891'	7816'	23, 26			K55, N80	8½"	-	

PERFORATED CASING (size, top, bottom, perforated intervals, size and spacing of perforation and method)
7" liner top at 3891', bottom at 7216'.
Perforations below 4100' are ½" holes drilled on 3" centers and 10 rows.

Was analysis of effluent made?	Electric log depths	Temperature depths
Yes ☐ No ☒	4216'	6916'

In compliance with Section 13-183-85 of Title 13, Sub-title 7, Chapter 183, Sub-chapter 12 of the Administrative Rules, of the Department of Land and Natural Resources, State of Hawaii, the information herewith is complete and correct as far as can be determined.

Name	Title	
W. L. D'Olier	Vice President, Exploration	
Address	**City**	**Zip Code**
601 California Street	San Francisco, CA	94108
Telephone Number	**Signature**	**Date**
415/981-5700	W. L. D'Olier	August 1982

DEPARTMENT

WELL SUMMARY REPORT - GEOTHERMAL

Operator: THERMAL POWER COMPANY			Well name and number: KAPOHO STATE 2		
Field: PUNA	County: HAWAII	Sec.: SEE SURVEY REPORT	T.	R.	B.&M.
Location (property or section corner, or street center lines): STATE GEOTHERMAL RESOURCES MINING LEASE R-2 KAPOHO, PUNA, HAWAII. (LICENCED SURVEYERS REPORT SHOWS EXACT LOCATION			Elevation of ground (feet above sea level): 717.87'		

Commenced drilling (date): 1-19-82	Total depth (feet): 8005'	Plugged depth (feet): N/A	Depth measurements taken from top of: ☐ Derrick floor ☐ Rotary table ☒ Kelly bushing
Completed drilling (date): 4-2-82	Geologic formation and age at total depth: BASALT		Which is 18 feet above ground.
Commenced producing (date): N/A			Geologic marker(s): NONE — Depth (feet): N/A
Junk: NONE			

DATE	STATIC TEST (Shut-in well head)		PRODUCTION TEST DATA								
			Total mass flow data					Separator data			
	Temp °F	Press psig	lb/hr	Temp °F	Press. psig	Enthalpy	Orifice	Water lb/hr	Steam lb/hr	Press psig	Temp °F
3-31-82	448	605	305,000	387	230	--	--	--	--	--	--

CASING RECORD (present hole)

Size of casing (A.P.I.)	Top of casing ft	Depth of shoe ft	Weight of casing lbs	New or second hand	Seamless or lapweld	Grade of casing	Size of hole drilled in	Volume of cement yd^3	Depth of cementing if through perforations ft
30"	SURFACE	28'	-			-	-	-	
20"	"	68'	94			H40	26"	12	
13 3/8"	"	1313'	54.5,61	ALL	SEAMLESS	K55	17½"	408	N/A
9 5/8"	"	4209'	36, 40	NEW		K55, N80	12¼"	190	
7"	3891'	7816'	23, 26			K55, N80	8½"	-	

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7" liner top at 3891', bottom at 7216'.
Perforations below 4100' are ½" holes drilled on 3" centers and 10 rows.

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Yes ☐ No ☒	4216'	6916'

In compliance with Section 13-183-85 of Title 13, Sub-title 7, Chapter 183, Sub-chapter 12 of the Administrative Rules, of the Department of Land and Natural Resources, State of Hawaii, the information herewith is complete and correct as far as can be determined.

Name: W. L. D'Olier		Title: Vice President, Exploration	
Address: 601 California Street		City: San Francisco, CA	Zip Code: 94108
Telephone Number: 415/981-5700	Signature: W. L. D'Olier	Date: 11 August 1982	

THERMAL POWER COMPANY, Operator 8 July 1982

GEOTHERMAL WELL HISTORY KAPOHO STATE 2

State Geothermal Resources Mining Lease No. R-2
Kapoho, Puna, Hawaii, State of Hawaii

Wellhead elevation above sea level: 717.87 feet Ground Level
735.87 feet Kelly Bushing

See Licensed Surveyor's Report, 1 March 1982, for Wellhead Location

Date & Depth	Operation
	Built 10' x 10' x 10' concrete cellar with 5' wide by 1' wainscoating and installed 30" conductor pipe to 28' prior to moving in rig. All downhole measurements herein are from Kelly Bushing.
01/19/82 54'	Finished moving in and installing noise reduction equipment on Water Resources International Rig No. 4. Kelly Bushing located 18' above ground level. Spudded well at 1100 hours. Mixed spud mud, picked up 12¼" bit and 26" hole opener and center-punched hole to 28'. Pulled out of hole (POH), laid down 26" hole opener and drilled with 12¼" bit (#1) to 54'.
01/20/82 103'	Drilled 12¼" hole 6 hours to 103'. POH. Laid down 12¼" bit. Picked up 17½" reamer and opened hole to 102'. POH. Laid down 17½" tools. Picked up 26" hole opener and opened hole to 37'. POH. Picked up 26" reamer and reamed hole to 42.5'.
01/21/82 103'	Continued opening hole to 68'. POH. Laid down 26" tools. Lost 11" slips into hole as 26" reamer was pulled out; fished out 11" slips. Cut off 30" conductor casing and ran 2 joints 20" 94# H-40 Buttress R-3 casing, total length 85.12'; set at 68'. Cemented with construction type cement with 2% $CaCl_2$. Cement in place (CIP) 1300 hours. Cut off 20" casing and nipple up Blow Out Prevention (BOP) equipment and rotating head. Picked up 17½" bit (#2), near bit reamer, shock-sub, upper reamer and 2-11" drill collars; drilled cement from 55' to 68', cleaned out fill to 91.4'. Note: one ± 5.4 Rm earthquake felt at site.

01/22/82 **174'**	Mixed mud and cleaned out to 103'. POH, laid down 1-11" drill collar and picked up double stand of 11" drill collars. Hooked up rotating head. Deviation survey at 92' was 0° 15'. Tripped in hole with 17½" bit (#2), near bit reamer, 11" shock-sub, 11" stabilizer/reamer, 3-11" drill collars, 1-8" drill collar and 3 cross-over subs (x-0 subs). Drilled 71' to 174'.
01/23/82 **250'**	Drilled 86' of hole in 6½ hours to 250'. POH. Secured rig for weekend shutdown at 2000 hours. Deviation survey at 217' was 0° 15'.
01/24/82 **250'**	Shut down for weekend.
01/25/82 **300'**	Started up and serviced rig and accessory systems at 0800 hours. Changed to new 17½" bit (#3); made repairs to hook. Tripped in to hole with drilling assembly and drilled 50' of hole to 300' in 5 hours.
01/26/82 **616'**	Drilled 316' of hole in 21½ hours to 616'; lost mud returns at 321'. Stopped twice, once to repair goose neck and once to install fan belt to air compressor.
01/27/82 **750'**	Drilled 134' of hole in 13½ hours to 750'; no mud returns. Spotted 200 bbls mud at 700'. POH. Pump 100 bbls mud down hole with mud pump. Deviation survey at 720' was 0° 45'. Rigged up to bail hole.
01/28/82 **765'**	Bailed hole for water sample for Hawaii DLNR. Fluid level found at 724' KB, 706' below ground level and 12' above sea level. Removed sand line off drum. Made repairs to hook. Tripped in to hole, mixed mud, spotted 200 bbls on bottom. Cleaned out fill to 750'. Drilled new 17½" hole to 765'; no mud returns.
01/29/82 **923'**	Drilled 158' of 17½" hole with gel mud for 23½ hours to 923'. ½ hour servicing rig.
01/30/82 **942'**	Drilled 19' of 17½" hole to 942'; no mud returns. Circulated and conditioned hole and POH. Deviation survey at 904' was 1° 00'. Secured rig for weekend shut-down at 0730 hours.
01/31/82 **942'**	Shut down for weekend.
02/01/82 **987'**	Started and serviced rig at 0800 hours. Ran new 17½" bit (#4) in hole, mixed mud and drilled 45' of hole to 987'; no mud returns.

02/02/82 **1232'**	Drilled 245' of 17½" hole with gel mud to 1232'; no mud returns.
02/03/82 **1315'**	Drilled 83' to 1315' in 19½ hours without mud returns. POH to 1160', mixed 250 bbls mud and lost circulation material (LCM). RIH to bottom, spotted 250 bbls mud and LCM. POH. Fluid level noted at 550' in wellbore.
02/04/82 **1315'**	Laid down 17½" tools. Cut off 20" casing and cleaned off cellar. Mixed mud and LCM. Pumped 500 bbls LCM mud while dumping cane pellets from surface. Mixed more LCM mud. Tripped in, washed from 1287' to bottom. POH to 1160'. RIH and found no fill. POH, laid down 17½" tools. Rigged up to run casing. Mixed 300 bbls of mud in pits.
02/05/82 **1315'**	Ran 30 joints 13-3/8" 54.5# K-55 Buttress R-3 and 3 joints 13-3/8" 61# K-55 Buttress R-3 on top. Guide shoe and float collar on bottom joint. Total string length was 1314.45'. Casing set at 1313'. Rigged cementers and pumped 350 bbls mud with 10-15% LCM, vis 65 sec., had no returns. Pumped 10 bbls water followed by 1153 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2 and 2% $CaCl_2$. Total slurry was 1477 cu. ft., 65% in excess of volume needed. Weight was 12.6-12.8 pounds per gallon (ppg). Displaced plug with 198 bbls water and bumped plug with 800 psi. CIP at 1130 hours. WOC 10½ hours. Cutoff 13-3/8" casing. Picked up 1.6" tubing, tagged cement at 564' in annulus. Mixed and pumped 143 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 2230 hours. Cement slurry weight was 13.4 ppg. WOC.
02/06/82 **1315'**	WOC, 5 hours total. Picked up tubing, tagged cement at 540'. Pumped cement plug (#2) with 210 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 0430 hours. WOC. Fluid level recorded at 434'. Laid down tubing. Shut down and secured rig for weekend.
02/07/82 **1315'**	Shut down for weekend.

02/08/82
1315'

Started and serviced rig and accessory systems at 0800 hours. Picked up and tagged cement with tubing at 463'. Pumped cement plug (#3) with 130 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2. CIP at 1045 hours. WOC 3½ hours. Blended new cement. Tagged cement with tubing at 454'. Pumped cement plug (#4) with 100 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 1520 hours, WOC 1½ hours. Pull out all 14 joints 1.6" tubing. RIH with same tubing 7 joints. Pumped cement plug (#5) with same volume and composition as plug #4. CIP at 1800 hours. WOC 4 hours. Pumped cement plug (#6) with same volume and composition as plug #4. CIP at 2215 hours. WOC.

02/09/82
1315'

WOC, 2½ hours total. Pumped cement plug (#7) with same volume and composition as plug #4. CIP at 0130 hours. WOC 2½ hrs. (Tubing is resting at 350'). Pumped cement plug (#8) with same volume and composition as plug #4. CIP at 0430 hours. WOC 3½ hours. Pumped cement plug (#9) with same volume and composition as plug #4. CIP at 0730 hours. WOC 2½ hours. RIH with tubing and tagged cement at 386'. Pumped cement plug (#10) with 200 cu. ft. composed as in plug #4. CIP @ 1130 hours. WOC 1 hour. POH and laid down tubing. Mixed Redimix 1:1 with sand, 40% silica flour, and 2% $CaCl_2$. Pour 8 cu. yds. from surface. WOC 1 hour. Again, pour 8 cu. yds. and WOC 4½ hours. RIH and tagged cement with tubing at 286'. Pumped cement plug (#11) with 147 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, and ½% CFR-2. CIP at 2100 hours. WOC.

02/10/82
1315'

WOC, 4 hours total. Tagged cement with tubing at 296'. Pumped cement plug (#12) with 130 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel and ½% CFR-2. CIP at 0130 hours, WOC 4½ hours. Tagged cement at 296'. Pumped cement plug (#13) with same volume and composition as plug #12. CIP at 0700 hours. WOC 6 hours. Pulled and laid down tubing. Blended new cement. RIH and tagged cement with tubing at 352". Pumped cement plug (#14) with 60 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ½% CFR-2, and 2% $CaCl_2$. CIP at 1330 hours. WOC 3½ hours. Pumped cement plug (#15) with same volume and composition as plug #14. CIP at 1750 hours. WOC 3 hours. Pumped cement plug #16 with same volume and composition as plug #14. CIP at 2100 hours. WOC 3 hours. Laid down tubing.

02/11/82 **1315'**	WOC 3½ hours total. Pumped cement plug (#17) with same volume and composition as plug #14. CIP at 0100 hours. WOC 3 hours. Pumped cement plug (#18) with same volume and composition as plug #14. CIP at 0430 hours. WOC 13 hours while cleaning cellar and waiting for new cement. Mixed Redimix 1:1 with sand, 20% silica flour, 1% $CaCl_2$, and poured two slugs of 8 cu. yds. from surface, with 1½ hours between pours. CIP at 2130 hours. WOC 2½ hours.
02/12/82 **1315'**	Poured 8 cu. yds. same as above. CIP at 0030 hours. WOC 7½ hours. RIH and tagged cement with tubing at 322'. Mixed Redimix cement 1:1 with ½" gravel, 40% silica flour, 3% $CaCl_2$, and poured four 1½ cu. yd. slugs ½ hour apart, 6 cu. yds. total. Tagged cement with tubing again at 322'. Mixed same Redimix mixture above and poured 2 slugs of 1½ cu. yd., then one slug of 5 cu. yds. each 30 minutes apart. WOC 1 hour. Tagged cement with tubing still at 322'. Dumped 7 cu. yds. of ¼" pea-gravel mixed with 10 bags cottonseen hulls in effort to pack off hole. Tagged top of gravel/cement still at 322' with tubing. Pulled out and laid down tubing. Dumped 14 cu. yds. ¼" pea-gravel and 8 bags cottonseed hulls, tagged top still at 322'. Pulled out tubing.
02/13/82 **1315'**	Dumped 15 cu. yds. ¼" pea-gravel from surface, tagged top again at 322'. Mixed and poured 8 cu. yds. of Redimix 1:1 with ½" gravel by pouring two-1½ cu. yds. slugs and then one 5 cu. yds, ½ hour apart. Shut down and secured for weekend. A total of 40 tons of ¼" pea-gravel were poured in plug attempt.
02/14/82 **1315'**	Shut down for weekend.
02/15/82 **1315'**	Shut down for weekend.
02/16/82 **1315'**	Picked up and tagged top of cement/gravel with tubing at 322' at 0800 hours. Dumped approximately 40 cu. yds. ½" volcanic cinders from surface. Tagged top of cinders at 320.5'. Dumped another 40 cu. yds. of ½" volcanic cinders.
02/17/82 **1315'**	Dumped another 25 cu. yds. of ½" volcanic cinders from surface. Tagged top of cinders at 320.5' with tubing. Rigged and dropped simultaneously four ½" x 20' lengths of rebar fixed each with one barbed wire tail, 50', 200', 240', and 260' in space between 13-3/8" and 20" casing. Was able to cement to surface with 7 cu. yards Redimix 1:1 with ½" gravel and 2% $CaCl_2$. CIP at 1300 hours. Cleaned off cellar. Cut off 13-3/8" casing. Mixed up gel mud in two pits. Rigged down tubing and cement tools. Welded up 13-3/8" Bradenhead wellhead.

02/18/82
1315'

Nippled up BOP stack. Pressure tested blind rams to 1000 psi - 15 minutes - held OK. Picked up old 12¼" bit, sub, 3-11" drill collars, 3 subs, 6-8" drill collars. Tripped in hole. Tested pipe rams to 1000 psi - 15 minutes - held OK. Tested Hydrill to 400 psi - 15 minutes - held OK. Drilled out float collar and 40' of cement to 1308'. POH mixed new gel mud. Changed to new 12½" bit (#6).

02/19/82
1384'

Deviation survey at 1300' was 1° 00'. RIH, drilled cement and casing shoe at 1313', cleaned out to 1315'. Circulated mud at 1315' for 4 hours while replacing damaged rotary chain. Drilled new 12¼" hole to 1357'. Tripped out, changed to new 12¼" bit (#7), tripped in, continued drilling. Tripped 1 hour to repair rotary chain guard. Continued drilling to 1384'.

02/20/82
1695'

Drilled 311' of 12¼" hole with 37 sec. viscosity gel mud to 1695' in 24 hours. Lost 20 bbl/hr. at 1500', 225 bbls total through drilling period.

02/21/82
1910'

Drilled 215' of 12¼" hole to 1910' in 24 hours. No mud loss.

02/22/82
2118'

Drilled 53' of 12¼" to 1963'. Tripped out of hole. Deviation survey at 1936' was 0° 45'. Changed to new 12¼" bit (#8). Cleaned shaker pit. Tripped in, cleaned 30' of fill off bottom. Drilled 155' of new hole to 2118'.

02/23/82
2444'

Drilled hole with gel mud. Lost 100 bbls mud from 2135'-2150'. Halted drilling. ½ hour to clean shaker pits. Resumed drilling, lost 100 bbls mud 2440'-2444'.

02/24/82
2701'

Drilling 257' of 12¼" hole to 2701'; minor mud loss at 2624'. Stopped ½ hour to clean #2 pit and shaker pit.

02/25/82
2996'

Drilled 295' of new hole to 2996'; no loss circulation this interval. ½ hour to clean shaker pit.

02/26/82
3242'

Drilled 246' to 3242'. ½ hour to clean #3 and shaker pit.

02/27/82
3353'

Drilled 51' in 5 hours to 3293'. Tripped out for bit change. Laid down 1 shock sub; pick up 1-11" x 20' drill collar plus new 12¼" bit (#9). Cut 56½' off of drilling line and rigged new line. Deviation survey at 3283' was 1° 30'. Tripped in hole, with drilling assembly (12¼" bit (#9), 2-12¼" near-bit reamers, 4-11" x 20' drill collars, 2-X-0 subs, 6-8" x 20' drill collars equalling 321.68'). Cleaned 5' of fill off bottom and drilled 60' of 12¼" hole to 3353'.

02/28/82 **3561'**	Drilled 214' of new hole to 3567'.
03/01/82 **3819'**	Drilled 252' of new hole to 3819'.
03/02/82 **4111'**	Drilled 292' of new hole to 4111'. 3^{o} temperature kick at 4028' along with 10 bbl loss.
03/03/82 **4217'**	Drilled 106' of new hole to 4217' in 4½ hours. Stopped drilling and circulated hole for logs. POH. Rigged up and ran temperature log (#1), Gamma-Ray Neutron log, X-Y Caliper, Resistivity log, Cement Bond log and additional temperature logs (#2 and #3). All logs were to 4214' except the CBL which was to 1313'.
03/04/82 **4217'**	Finished logging and rigged down. Start in hole and found no fill on bottom. Circulated hole at 4214' for 2 hours, conditioning for 9-5/8" casing. POH and laid down all drill pipe, collars and tools.
03/05/82 **4217'**	Ran 13 joints of 9-5/8" 40# N-80 Buttress T&C R-3 following 62 joints 9-5/8" 40# K-55 Buttress T&C R-3 casing with float collar and shoe on first joint. Casing was hung in 9-5/8" x 13-3/8" Midway hanger at 1096'. Shoe was run to 4214', pulled up and set at 4209'. Total pipe length was 3104'. Circulated casing shoe at 3233' for ½ hour. Pumped 100 bbls cool mud, 10 bbls cool water, 16 bbls salt gel flush (30 lbs/bbl), second 10 bbl slug of water, 30 bbls Flo-check and third 10 bbl slug of water. Cemented casing with 1021 cu. ft. cement mixed 1:1 with Perlite, 40% silica flour, 3% gel, ¼% CFR-2 and 0.4% HR-7. Slurry weight was 12.7-13.3 ppg. Chased with 350 cu. ft. cement with 40% silica flour, 3% gel, ½% CFR-2, 0.4% HR-7 at 14 ppg slurry weight. CIP at 1400 hours. WOC 8 hours. Released liner, pulled pipe 60' up. circulated in 13-3/8" casing, no cement returned to surface in circulating material. Laid down drill pipe and changed out kelly.
03/06/82 **4217'**	WOC 8 hours. Picked up 16-6 3/4" drill collars and 12-3/4" bit. Tripped in hole, tagged top of cement at top of liner (1096') no cement was above liner. Pressure tested liner lap to 1200 psi, took water at 4 bbl/min pressure dropped to 300 psi. Rigged up to squeeze cement. RIH with open ended drill pipe (OEDP) to 1040' and squeezed 102 sacks cement mixed with 40% silica flour, 3% gel, ½% CFR-2. CIP at 1500 hours, Displaced pipe with water to 1076', left 20' of cement above liner top. POH and WOC 4½ hours. Trip in hole with 12¼" bit, tagged top of liner at 1096', no cement on liner top. POH.

03/07/82
4217'

Pressure tested liner lap to 1000 psi for 15 minutes. Held OK. Laid down 12¼" bit and picked up 8-3/4" bit. RIH to 1104' and drilled cement to 1109'. RIH to 1601'. Pressure tested pipe rams to 1000 psi for 15 minutes. Held OK. POH and laid down pipe. Rigged up for logging and ran 22 joints 9-5/8" 36# K-55 Buttress T&C R-3 with stinger (liner attachment) on bottom and float collar on top of first joint and then 5 joints 9-5/8" 40# K-55 Buttress T&C R-3. Stinger set at 1096', total length of string was 1103.4'. Cemented by pumping 567 cu. ft. Cement mixed with 40% silica flour, 3% gel and ½% CFR-2, slurry weight was 15.3-15.5 ppg. 15 bbls cement surfaced and was sumped. CIP at 2230 hours.

03/08/82
4217'

WOC 17½ hours and cut off 9-5/8" casing, nippled up expansion spool and flow nipple. RIH with 8-3/4" bit, drilled out cement and float collar 1040' to 1096' through 9-5/8" casing tie back element. Picked up additional 4" drill pipe and RIH to clean out 9-5/8" casing float collar at 4165'.

03/09/82
4217'

Picked up and stood 4" drillpipe in derrick while cleaning out cement to 4214'. POH. Laid down 12½" bit (#10). Ran cement bond log 0' to 4214'. RIH to 1500' with OEDP, mixed and pumped 43 cu. ft. cement for a 100 liner foot cement plug. Displaced pipe with water and POH. Pulled flow nipple from wellhead stack and nippled up BOP. WOC 5½ hours. Mixed salt gel mud to use as flush when required on water below 4217'.

03/10/82
4217'

Finished nippling up BOP on 9-5/8" casing. Tested blind rams and choke manifold to 1200 psi for 15 minutes - held OK. Picked up 8-3/4" bit (#11), 6½" near-bit reamer, 2-6½" stabilizer subs (36' and 96' above bit), and 16-6 3/4" drill collars. Tripped in hole 1000'. Tested pipe rams and kelly stop at 1200 psi for 15 minutes - held OK. Tested Hydril to 600 psi for 15 minutes - held OK. Tripped in hole to 1395', tagged top of cement and drilled same to 1458'.

03/11/82
4616'

Finished drilling out cement to 1490' and circulated hole clean. RIH to bottom and began drilling new 8-3/4" hole with water. Drilled 399' of hole to 4616' stopping 1½ hour to pull bit into 9-5/8" casing and pack the swivel. There was a 3° temperature kick at 4460'.

03/12/82
5221'

Drilled 8-3/4" hole until 0600 hours where ½ hour was taken to repair leaks in mud line unions. Resumed drilling for a 605' total to 5221'. Cleaned out shaker pit. Noted a 3° temperature kick at 5069'.

03/13/82
5623'

Drilled 402' of 8-3/4" hole to 5623' in 13½ hours. Lost 8-10 bbl/hr during drilling. Stopped drilling and circulated hole for bit change. POH while cleaning mud return pits. Deviation survey at 5599' was 4° 45'. Changed to new 8-3/4" bit (#12). Tripped collars in hole, set rotating head and cut 59½' of drilling line.

03/14/82
6202'

Finished cutting drilling line. RIH to 4200' circulating. Break circulation and RIH to 5623', found no fill on bottom. Drilled new 8-3/4" hole 579' to 6202' in 21 hours. Cleaned shaker pits. Dumped in 50 sacks of fine mica to halt 50 bbl/hr fluid loss which began at 5921'.

03/15/82
6456

Drilled 254' to 6456' in 12½ hours. Tripped out to change bit and found one bearing seal was lost (attributed to heat) and parts left in hole. Changed to new 8-3/4" bit (#13) and put junk sub above bit to collect parts left from bit #12. RIH, circulating 20 minutes at 4000' and 5500', resumed drilling.

03/16/82
6618'

Drilling 416' to 6618' in 10½ hours using water. Circulated for trip out to change bits. Tripped out, laid down bit #13 and junk sub. Deviation survey at 6600' was 5° 00'. RIH with new 8-3/4" bit (#14), circulated to cool bit 15 minutes each, at 4000', 4600', 5200', 5800', and 6200' and reamed 50' of fill off bottom.

03/17/82
7029'

Finished reaming to bottom. Drilled 591' of new hole to 7029' in 23 hours. Lost 30-50 bbl/hr during this period, specifically at 6638 and 6695'.

03/18/82
7073'

Drilled 44' in 3 hours to 7073'. Hole got tight, worked tight drill pipe out of hole to 6980'. Circulated 1½ hours and washed back to bottom. Pumped 100 bbls mud through well. POH and was still tight to 6980'. Tripped out of hole, laid down near bit reamer and 2 stabilizers. Cut 14½' off drilling line. Changed out rotating head rubbers while waiting on water to be hauled to site. Filled pits with water. Bit #14 was found to have two blown seals and loose cones. RIH with 8-3/4" bit (#15), 2 subs and 16-6 3/4" drill collars. Circulated 15 minutes each at 4555', 5272', 5898', 6520', 6800' and 6955'. Washed hole last two joints and found no fill.

03/19/82
7150'

Finished washing hole. Began drilling new 8-3/4" hole. Began caving in at 7150'. Worked 5 tight joints of drill pipe out of hole to 6680'. Regained lost circulation, POH to shoe of 9-5/8" casing. Decided to convert to mud drilling fluid to protect deep wellbore. Circulated and replaced water with mud to shoe of 9-5/8" casing. Rebuilt mud volumes in pits.

03/20/82
7213'

RIH, circulating mud 10 minutes at 600' intervals to cool bit and replace water with mud. Reamed 190' of fill to bottom and circulated 100 bbls heavy mud, brought up cuttings. Drilled 63' to 7213' in 3 hours, at 7213' suddenly lost 500 bbls at 270 bbl/hr rate. Tripped and circulated in effort to regain lost circulation. POH to 9-5/8" casing shoe and regained lost circulation. Mixed mud; filled hole and mud pits. Tripped in hole circulating 15 minutes at 600' intervals to 7048'. Cleaned 90' of fill to 7203'.

03/21/82
7236'

Finished cleaning to bottom, circulated and conditioned well at 7156'. Cleaned remaining 30' of fill to bottom and then lost all returns. POH to 6583', built up mud volume in pits and well. RIH to 7090', circulated and washed to 7183' and circulated there with high viscosity (80 sec., 8.6 ppg) mud. Able to drill new hole 1½ hour to 7227'. Tripped and circulated for bit change. Tripped out. Changed to new 8-3/4" bit (#16). Did rig repairs, RIH to 9-5/8" casing shoe, circulating each 15 minutes, and circulated thereafter 15 minutes at 600' intervals to bottom cleaning 60' of fill. Began drilling new hole 9½ hours to 7236' losing 150 bbls.

03/22/82
7554'

Drilled 10 hours, circulated bottoms up at 7398', pulled up to 6444'. Tripped back in, found and cleaned 74' of fill. Drilled another 11 hours for a total of 311' to 7554'.

03/23/82
7897'

Drilled 343' of 8-3/4" hole with mud to 7897'.

03/24/82
8005'

Drilled 108' in 9 hours to 8005' (TD). Circulated for 2 hours. Worked tight pipe out of hole first 7 joints losing 200 bbls of mud. Pulled to 4170'. Cut portion of drilling line. Tripped in hole to 7764' and circulated for 10 minutes. RIH found top of fill at 7821' and circulated 3 hours. Allowed pipe to sink in fill, found it soft, 10,000 lb. going in, 20,000 lbs. to pull out of fill. Pulled up and circulated at 7764' for Electric logs.

03/25/82 **8005'**	Circulated at 7764' and at 7804' for 12 hours for logs. Tripped out of hole. Rigged up and ran Temperature log 200' to 4260'. Rigged down and laid down drill collars.
03/26/82 **8005'**	RIH with 7" x 9-5/8" liner hanger on end of 64 lengths drill pipe. Set liner at 7816'. POH. Rigged up and ran 90 joints, 7" 23# K-55 Long T&C R-3 liner perforated with ½" holes on 3" centers, 10 rows and 3 joints solid 7" 26# N-80 Long T&C R-3 on top. Set liner on top of fill at 7816.2'. String was 3835.2' long with top of hanger at 3981'. POH with liner tools and laid same down. Trip in with float sub on bottom of drill pipe and dislaced mud with water at 4000' and 6000'. Tripped in and washed hole 7636'-7816' displacing mud with water. POH and rigged up to log. Well took 200 bbls of water at 30 bbl/hr during circulation.
03/27/82 **8005'**	Ran Gamma-Ray Neutron log 4150'-6005' and two Temperature logs 100'-5975'. Secured rig for weekend shutdown.
03/28/82 **8005'**	Shut down for weekend.
03/29/82 **8005'**	Opened well and tried to flow. No flow. Rigged up and ran wireline temperature survey with Kuster tool. Temp. @ 3620' = 200° F Temp. @ 7816' = 619° F
03/30/82 **8005'**	Finishing temperature logging. Hook up air compressor to blow well free of water head. RIH with OEDP to 615' and blow off water. RIH to 1100' and blow off water. RIH to 1400' and blow off water.
03/31/82 **8005'**	Blow off water at 1400'. RIH to 1640' and blow off water. POH to 1400' and blow off water. RIH to 1820' and blow off water, 300° F slugs of water came up, closed pipe rams on 9" drill pipe. Well flowing hot, strong-dirty. Flow cut out a hole in manifold of 6" flow line. Shut in well with maximum WHP of 353 psig.
04/01/82 **8005'**	WHP at 0 psig. POH with 4" drill pipe. Ran wire with sinker bar, bar hit bridge at liner top (3835'). POH with sinker bar. RIH with 6" drill bit and knocked out bridge at 3835', found well clear to 4231'. Tripped bit out. Ran sinker bar, bar hit bridge at 5052'. Elected not to go back in hole to knock out bridge. Began temperatre logging.

04/02/82 **8005'**	Completed temperature logging. Temperature at 5000', was 543° F. Laid down 4" drill pipe and Kelly. Ran fluid level indicator, level at 495'. Installed second 900 Series WKM 10" gate valve. Rigged down equipment. Released rig at 1800 hours on 4-2-82.

Verified:

W. L. D'Olier
Vice President, Exploration

SSW/ikl
08/04/82

THERMAL POWER COMPANY - Operator

Kapoho State 2

Static Wellbore Temperature Survey* - 4/29/82

Depth in Feet	Temperature	
	°C	°F
4000	322.2	611.9
4200	324.7	616.5
4400	326.8	620.2
4600	328.5	623.3
4800	330.4	626.7
5000	332.6	630.6
5200	334.7	634.4
5400	336.5	637.5
5600	338.0	640.3
5800	339.7	643.4
6000	341.6	646.8
6200	343.8	650.9
6400	344.7	652.5
6600	346.2	655.1
6800	347.4	657.3
6916	348.8	659.9

* Pruett Wireline Service; tool stopped at 6916 feet probably on mud bridge.

SSW/ikl
08/03/82
HA-PU-BR-B01

THERMAL POWER COMPANY - Operator

Kapoho State 2

Wellbore Deviation Survey

Depth in Feet	Deviation in Degrees
92	0.25
217	0.25
720	0.75
904	1.00
1300	1.00
1936	0.75
3283	1.50
5599	4.75
6347	5.00
6600	5.00 (to bottom)

True depth	=	7995.03 feet
Possible maximum drift from center	=	399.32 feet

SSW/ikl
08/03/82
HA-PU-BR-B01

PUNA GEOTHERMAL VENTURE

TWO GEOTHERMAL WELLS DRILLED AND COMPLETED

KAPOHO STATE 1 7290' TD NOV. 81

13-3/8" K-55 54.5 POUND BUTTRESS TO 903'

9-5/8" N-80, K-55 40 POUND BUTTRESS TO 4072'

7" PREPERFORATED LINER: 3897' TO 7216'

7" SOLID CASING SLEEVE: TO 1898' IN MAY 82

TEST FLOW: 100% STEAM 72,000 LBS/HR 120 PSIG

MAX TEMP RECORDED: 650°F OR 343°C AT 6400'

KAPOHO STATE 2 8005' TD APR. 82

13-3/8" K-55 54.5 POUND BUTTRESS TO 1313'

9-5/8" K-55 & N-80 40 POUND BUTTRESS TO 4209'

7 PREPERFORATED LINER: 3908' TO 7816'

TEST FLOW: 100% STEAM 41,000 LBS/HR 120 PSIG

MAX TEMP RECORDED: 670°F OR 355°C AT 6900'

PUNA GEOTHERMAL VENTURE

ROCK SECTION: **BASALT LAVAS AND DIKES**

700-1300' AQUIFERS 900F OR 320C

2500-4000' IMPERMEABLE ROCK

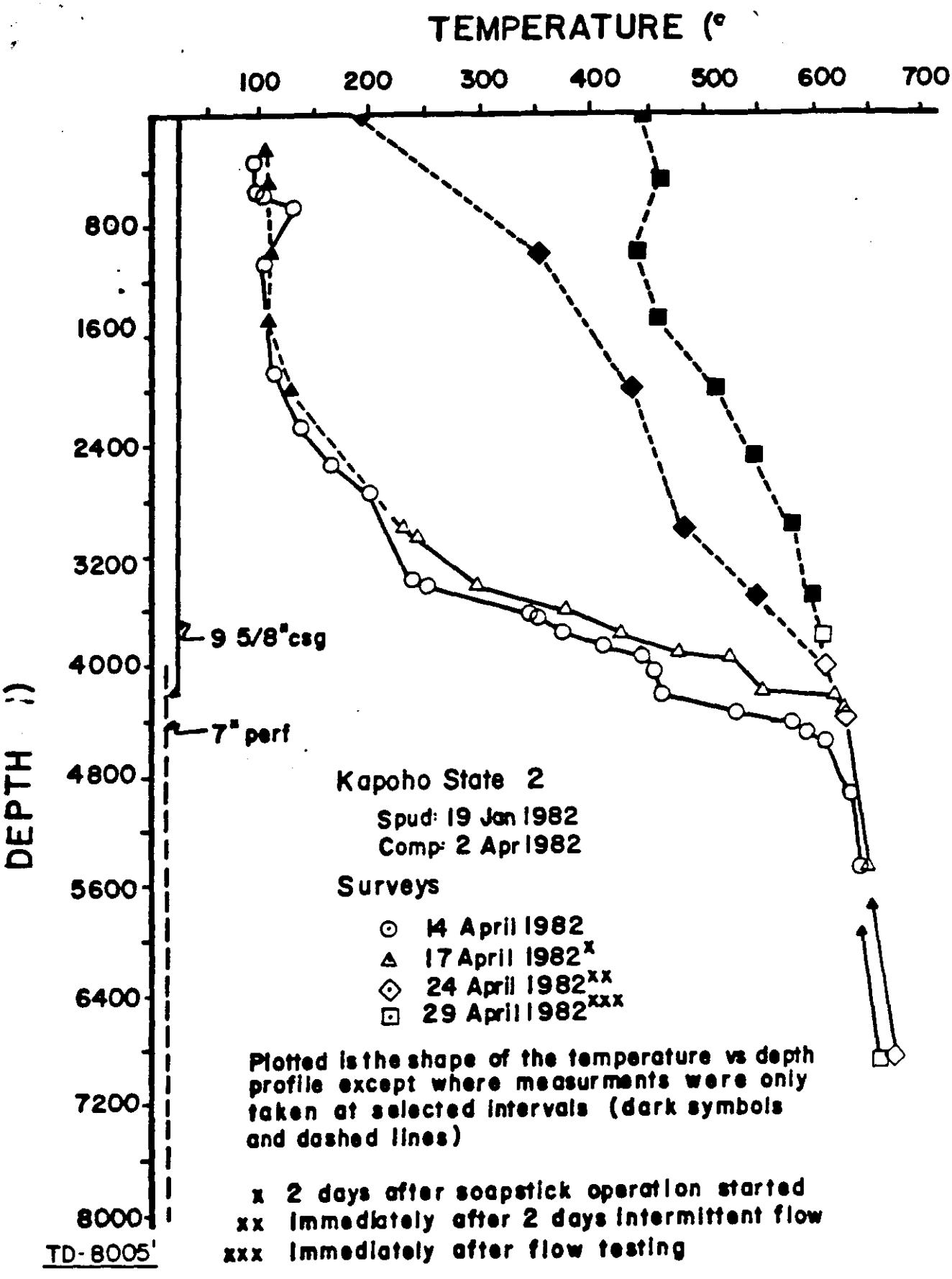
RESERVOIR: THREE PRODUCTION ZONES

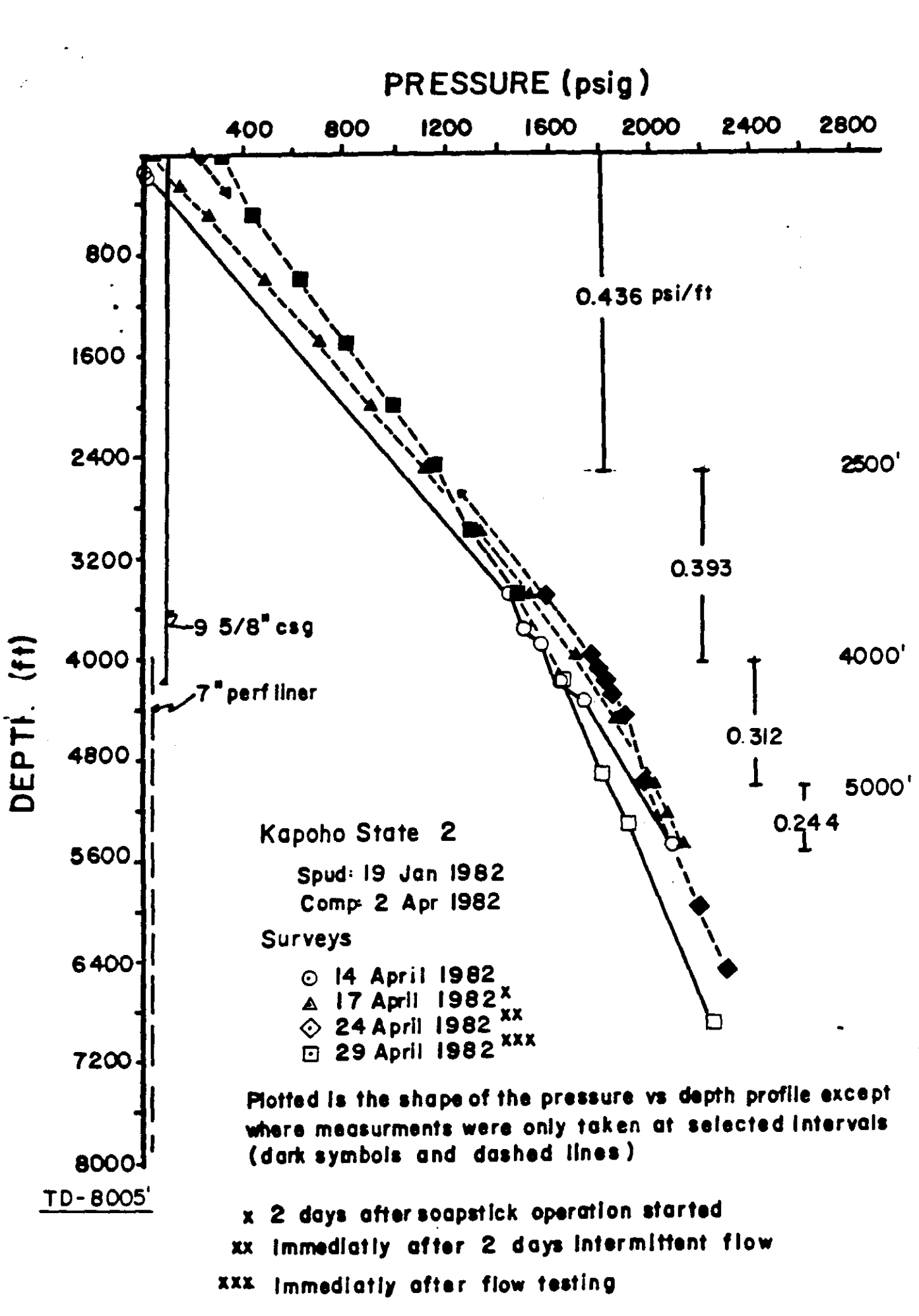
	DEPTH	CHARACTER	TEMPERATURES	
	4300'	LIQUID DOM?	500°F	260°C
	6000'	TWO PHASE	605°F	353°C
✓	7200'	TWO PHASE?	700°F	371°C

PRODUCTION: FAVORABLE 100% STEAM

- LOW TOTAL GAS, BUT H_2S AT 1100 PPM
- HIGH PRESSURE-TEMPERATURE UPON OPENING WELL TO FLOW

RESERVES: **ESTIMATED 25 MW**


TEMPERATURE (°
100
200
300
400
500
600
700
800
1600
2400
3200
4000
4800
5600
6400
7200
8000
DEPTH ')
9 5/8" csg
7" perf
TD-8005'
Kapoho State 2
Spud: 19 Jan 1982
Comp: 2 Apr 1982
Surveys
14 April 1982
17 April 1982x
24 April 1982xx
29 April 1982xxx
Plotted is the shape of the temperature vs depth profile except where measurments were only taken at selected intervals (dark symbols and dashed lines)
x 2 days after soapstick operation started
xx Immediately after 2 days intermittent flow
xxx Immediately after flow testing


PRESSURE (psig)
400
800
1200
1600
2000
2400
2800
DEPTH (ft)
800
1600
2400
3200
4000
4800
5600
6400
7200
8000
TD-8005'
0.436 psi/ft
0.393
0.312
0.244
2500'
4000'
5000'
9 5/8" csg
7" perf liner
Kapoho State 2
Spud: 19 Jan 1982
Comp: 2 Apr 1982
Surveys
⊙ 14 April 1982
△ 17 April 1982 x
◇ 24 April 1982 xx
⊡ 29 April 1982 xxx
Plotted is the shape of the pressure vs depth profile except where measurments were only taken at selected intervals (dark symbols and dashed lines)
x 2 days after soapstick operation started
xx Immediatly after 2 days intermittent flow
xxx Immediatly after flow testing

PUNA GEOTHERMAL VENTURE

WELL FLOW TESTING PROBLEMS

- OPENING PRESSURE TO 1350 PSIG AND TEMPERATURE PEAKS TO 580°F OR 305°C REQUIRES 900 SERIES WKM WELLHEAD GATES

- PARTICULATE MATTER ERODED VALVES AND PIPING RESULTING IN SHUTDOWNS

- CHEMICAL ABATEMENT ALSO CAUSED CUT-OUTS IN TEST FLOW LINE RESULTING IN SHUTDOWNS

- FLOW STOPPAGES CAUSES DEBRIS BUILDING IN WELLBORE

- SHALLOW THERMAL STRESS LEADS TO CASING FAILURE

    - MARKED THERMAL FLUX UPON OPENING
    - REPEATED THERMAL CYCLING

PUNA GEOTHERMAL VENTURE
STATUS AND OPTIONS

WELL STATUS

KS-1 SUSPENDED: CEMENT PLUG 1750-2250'

KS-2 SUSPENDED: CEMENT PLUG 2994-3225'

BOTH STABLE-SAFE - NO WELLHEAD PRESSURE

WELL OPTIONS

ABANDON KS-1 PRODUCTION ZONE AND CONVERT TO INJECTION OR WATER SUPPLY WELL

REDRILL-RECOMPLETE KS-2

DRILL NEW WELL

STATUS (Suspended)

KS #2:

1) a) wireline debris in 9 5/8" casing at 3976' depth

b) 9 5/8" to 13 3/8" casing lap leak between 1050' to 1313' depth (~1040 to 1050')

- after DOGM approval dated 12/21/82 for 180-day extension of drill permit (expiration 7/7/83) for K.S. #2, was any additional work done at the site?
- Thermal Power Co. requested an extension in their letter to DOGM dated 12/14/82.

* From 12~~/31~~/82 to ~8/10/83 no memos or letters recd.
- No data available re: static water level or results from ground water sample, if taken at all.

2) Completions reports filed on 8/11/82 (recd 8/13/82) by Thermal Power Co.

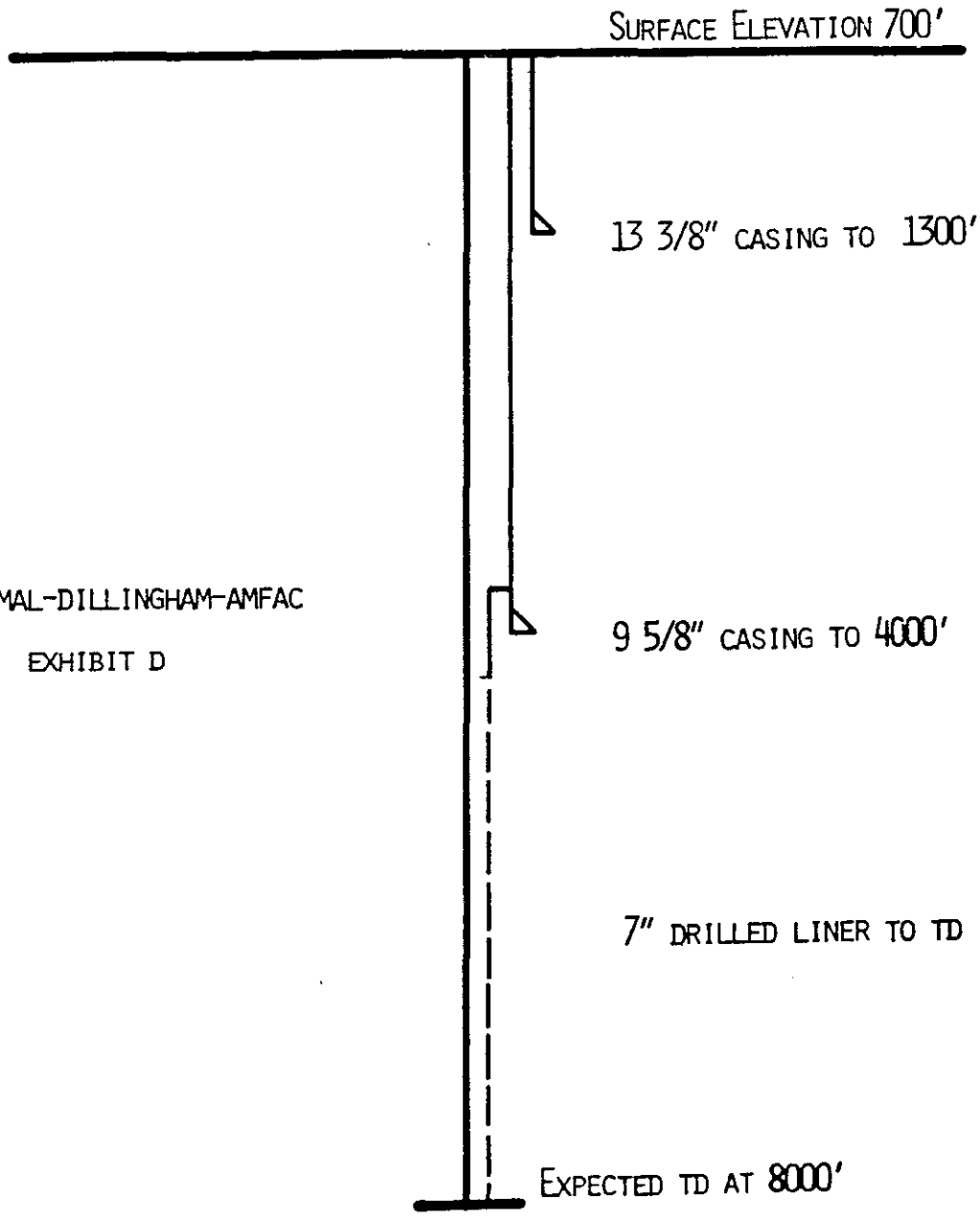
3) Well Activity Summary dated 8/10/83 held in Confidential files:
a) reports on remedial work and wellbore evaluation.
b) KS #2 - suspended and cement plugged @ (2994' - 3225') depth.

4) per conversation w/ R. Patterson: K.S. #2 can be rehabilitated, ~~and~~ (wireline should have become brittle ~~and~~ to H_2S) further testing may be planned depending upon results from K.S. #1-A.

Thermal Power Company

Kapoho State 2- Geothermal Well

Vertical Section



THERMAL-DILLINGHAM-AMFAC

EXHIBIT D

SSW- 11/81

May 6, 1982

MEMORANDUM FOR THE RECORD

FROM: Ed Sakoda

SUBJECT: Geothermal Well Test - Kapoho State No. 2

On April 21, 1982, Dan Lum and I were observers at the testing of Kapoho State No. 2 geothermal well. The well was gradually "brought in" by slowly releasing the pressure through two bleeder valves. The main valve was then opened and the pressure released through the main system.

The noise muffling system consisted of piping the steam into a 15 feet deep rock-filled pit with a perforated pipe system. The system worked until abrasion by particles in the steam wore a hole in the elbow section of the pipe.

An H_2S abatement system was hooked up to the steam discharge and used, although not needed because of little or no H_2S from the well.

The well was flashed through the muffler for several hours until the hole was worn in the elbow bend. The steam was then vented directly through the well stack. The well was shut down in the evening.

On Thursday morning, the water level in the well had dropped and the well would not flow. Periodic water level measurements were taken to determine the rise or fall of the water level.

By Friday morning, pressure had built up in the well sufficiently to flash the well. A larger diameter stack was installed hoping to reduce the noise. It was noted that fine sand-sized particles were being blown from the well. The well was planned to be cleaned out for as long as possible - perhaps as much as six days.

E. Sakoda

ED SAKODA

ES:ko

State of Hawaii

DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT

P. O. Box 373
Honolulu, Hawaii 96809

MESSAGE REPLY

TO MR. ROBERT T. CHUCK - MANAGER-CHIEF ENGINEER DATE

Subject: Geothermal Well

Kapoho State No. 2

DATE February 10, 1982

The following conditions were observed:

a. Size of hole drilled = 17½ inches

b. Depth of hole drilled = 1315 feet

c. Total casing installed = 1313 feet

d. Size of casing installed = 13 3/8 inches

Drilling contractor prepared pipe assembly for grouting of annular space.

DEC 16 AM 11:25

BY SIGNED

0-600 ppm (Cl) = fresh
<250 ppm = "potable" drinking water
600-10,000 ppm = brackish
>10,000 ppm = saline